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DEVICE AND METHOD FOR CONVERTING DATA SEQUENCES
BETWEEN FR FORMAT AND ATM FORMAT

The asynchronous transfer modus (ATM) serves as a basis for a universal and international broadband communication, whose configuration ~~are~~ [sic] standardized by means of the ATM forum found in the year 1991.

The asynchronous transfer modus is an asynchronous time-division multiplexer method, which enables an integration of different communication services, such as voice communication, data communication, video telephone, video communication etc. given an arbitrary scaling ability of the transmission capacity. The structure of a typical ATM cell is represented in Rathgeb, Wallmeier, page 79, for example.

Network accesses having transmission rates of 64 kbit/s up to 45 Mbit/s are enabled by means of "Frame Relay", whereby the data frames can have a variable length up to 8 kbytes. FR network accesses are particularly suitable for the ~~data~~ communication ^{29.1 in the Internet} (internet, for example). The specifications are standardized by means of the FR forum. The structure of an FR frame is described in Rathgeb, Wallmeier, page 269 through page 271, for example.

The conversion of data sequences between FR and ATM format ("interworking") can be carried out as a ~~what is referred to as~~ network interworking ^{in which}, whereby the FR frames are directly converted into corresponding ATM frames and vice-versa or can be carried out by means of ^{"service interworking"} a ~~what is referred to as~~ service interworking, whereby the content of the FR frames are converted into an AAL5 (ATM adaption layer 5) cell stream. The network interworking is described in FR forum document No. FRF. 5 and the service interworking is described in FR forum document No. FRF. 8.

Given the transmission from one format to the other one, the frames must be frequently translated in their control data area (header), particularly regarding the service interworking. For this purpose, the frames

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operation of the central computer need not be interrupted during the readin and readout of the data. Therefore, the data throughput rate is clearly increased. The process of the data transmission between the communication modules and the buffer memory is ^{via} ~~thereby~~ also controlled ~~by means of~~ the central computer. However, this control function contributes only to a small increase in work load of the central computer.

Preferably, the communication modules, the buffer memory and the central computer are connected ^{via} ~~by means of~~ a bus link, particularly ^{via} ~~by means of~~ a high-capacity PCI bus. A separate bus link can also be provided for each of the communication modules.

For purposes of achieving a further increase of the throughput rate, it is possible to divide the buffer memory into two units, whereby one unit is fashioned for storing the data for the further processing in the FR communication module, ^{and} the other unit for storing data for the further processing in the ATM communication module. The utilization of two separate central computers ^{an} is advantageous ~~about such an~~ arrangement, ^{in which each computer is} ~~whereby respectively one is~~ responsible for one "communication direction".

BRIEF DESCRIPTION OF THE DRAWINGS
Exemplary embodiments of the present invention are described on the basis of the enclosed ^{drawings} ~~drawing~~. Shown are:

- 20 Figure 1 ^{is} a schematic representation of a first exemplary embodiment of the inventive conversion device;
- Figure 2 ^{is} a schematic illustration of a second exemplary embodiment of the inventive conversion device;
- 25 Figure 3 ^{is} a schematic illustration of a third exemplary embodiment of the inventive conversion device;

Figure 4

a schematic representation of a fourth exemplary embodiment of the inventive conversion device and

Figure 5

a schematic representation of a fifth exemplary embodiment of the inventive conversion

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a first exemplary embodiment of the inventive

conversion device. In this example, eight communication links of the type E1/DS1 (transmission capacity 2.048 Mbit/s or, respectively, 1.544 Mbit/s are connected to the FR communication module. However, arbitrary other communication links that are possible in the FR standard can be utilized.

The FR communication module PIM (Physical Interface Module) consists of two functional modules, the physical interface PHY and the FR control FRCC (Frame Relay Communication ^{Controller} _{Unit}). The FR communication

module PIM is connected via a PCI (Peripheral Component Interconnect) bus to the ATM communication, which, in turn, consists of the segmentation/chaining unit SAR, ^{by which} _{within} the AAL5 (ATM Adaption Layer) functionality is implemented ^{therein}, and consists of the ATM adaptation layer ALM, which are connected to one another via an ^{an} utopia (Universal Test and

Operations Physical Interface for ATM) interface. The buffer memory PSSM (PIM SAR Shared Memory), which comprises a dynamic direct access ^{memory} (DRAM) and an appertaining memory controller, is also connected to the PCI

bus. Besides, the central computer FP, which, for example, can comprise a ~~RISC~~ ^{RISC} CPU, a system control, a storage unit, a clock control etc., is connected to the PCI bus.

The second exemplary embodiment of the inventive conversion device shown in Figure 2 only differs from the first exemplary embodiment in that separate bus links are provided between ^{the} FR communication module and ^{the} buffer memory, on one hand, and between ^{the} ATM communication module and ^{the} buffer memory, on the other hand. Both bus links are connected to the

central computer FP, which controls the data transmission processes on the bus links.

In the third exemplary embodiment of the inventive conversion device schematically shown in Figure 3, the buffer memory PSSM is divided into two units for purposes of further enhancing the performance, ^{in which} whereby the first unit serves the purpose of transmitting from the FR side to the ATM side and the second unit serves the purpose of transmitting from the ATM side to the FR side.

In the fourth exemplary embodiment of the inventive conversion device shown in Figure 4, the FRCC module in the FR communication module PIM and the SAR module in the ATM communication module are also fashioned in a two-piece manner, ^{in which each respective} whereby ~~respectively one part is~~ responsible for one transmission direction. Therefore, a further increase in speed can be achieved, ^{but} ~~whereby, on the other hand,~~ the constructional outlay increases, too.

The conversion device of the third exemplary embodiment, which is shown in Figure 5, additionally contains separate bus links for the readin process into the buffer memory PSSM, on one hand, and for the readout process from the buffer memory, on the other hand. For both transmission directions, the readin and readout process therefore can be carried out independently of one another, so that a further enhancement of the transmission performance is enabled.

The method of functioning of the conversion devices that are schematically shown in Figures 1 through 3 is explained in the following. FR data sequences are read from the physical interfaces by the FR communication module PIM and then are stored in the buffer memory PSSM upon control by means of the central computer FP. Subsequently, the data are read-in the ATM communication module, upon control ^{via} ~~by means of~~ the central computer again, via the PCI bus. The segmentation/chaining unit SAR carries out the interconnecting of the header data and the chaining of

the data to be transmitted into ATM cells, which are supplied via the utopia interface of the ATM adaptation layer - processing unit ALM and are made available there at output terminals Y_b , for the further processing in a coupling field, for example.

5 Given the reversed conversion, the data sequences get in the ATM format from the ATM adaptation layer - processing unit, via the utopia interface, to the segmentation chaining unit SAR, ^{in which} whereby the ATM cells are chained ~~there~~ and are stored via the bus link into the buffer memory PSSM. From there, the data are read-in ^{via} ~~by means of~~ the FR communication module PIM, are converted into the FR format with frames of variable length, and are
10 subsequently supplied to one of the physical interfaces.

 As a result of the temporary storing of the converted data via the internal communication link in the buffer memory, an interruption of the operation of the central computer FP is not required when the data are read-
15 in/readout. The control of the readin/readout process, on one hand, the translation of the FR headers in the network IW case and ^{on the other hand,} the conversion in the service IW case, ~~on the other hand,~~ requires only a few accesses via the PCI bus and therefore represents only a small load for the central computer. Thus, a performance enhancement of the conversion device by ^{a) of} the factor 2
20 through 3 and higher can be achieved.

 The PCI burst capability of all connected PCI bus users and also the performance capacity of the central computer FP are conditions with respect to a high transmission performance. Although the central computer FP does not access the buffer memory PSSM too often, its conversion speed
25 must be high given the service interworking functionality.

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